Space Weather Technical Forecast

Issued on Friday 21 February 2025 at 01:12 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-class flares. Possible glancing CME's day 3 (23 Feb).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with peak flare C4.9 at 20/1501 UTC from AR3996 near centre disc at the time. There are seven sunspot numbered regions on the visible disc, and several small unnumbered regions of which most have developed during the period. Most numbered regions on the visible disc are relatively small and simple, with little growth or development observed. However, modestly sized AR3996 and also AR3998, in the southwest, remain the most notable regions on the disc, with some mixed magnetic complexity and a slight increase in flare activity through the period.

A filament was observed to lift off from the southeast, beginning around 20/0500UTC, with a narrow, south directed CME now confirmed to be directed well below Earth orbit. Flaring in the vicinity of AR3996 around 20/1000 UTC, as it approached centre disc, produced a CME that may glance Earth on day 3 (23rd Feb).

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE and DSCOVR at L1 were predominantly slightly elevated and in the range of 450-500km/s. However, late in the day the solar winds decreased to background levels, ending the day near 380 km/s, indicating the residual declining influence of the HSS from CH15. Density was initially above average, reaching 14 ppcc, but then gradually declined to end the day below average. Interplanetary Magnetic Field, Bt, was Weak at 7nT or less. The north-south component was mainly negative (southward) with peak -6nT. Phi angle was mostly negative (towards the Sun), although did fluctuate for a time in the middle of the afternoon. Geomagnetic activity was Unsettled (Kp 3) between 20/0000-0600 UTC, otherwise Quiet (Kp 0-1).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 persisted at Background. High energy electron flux (greater than 2MeV) at GOES16 was Moderate, peaking at 307pfu at 20/1705 UTC. The associated 24-hour fluence was below the Active threshold (1e8 integrated pfu), with the 21/0000UTC observation being 9.21e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be generally Low, with a chance of isolated M-class flares.

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Solar Wind / Geomagnetic Activity:

A CME followed a C8 flare at 19/2345 UTC from a now decayed region in the southwest, with modelling results indicating a chance of a glancing blow around the middle of the day (UTC) on day 3 (23 Feb). There is a lower chance of another CME brushing Earth on day 3, although earlier in the day, from flaring that occurred in the vicinity of AR3996 on the 20th.

No significant solar wind enhancements are expected over the next few days, with a gradual easing trend within background levels expected from previous CH15. However, on day 3 (23 Feb) there is a chance of two glancing CME's as mentioned above. Late Day 4 (24th) a weak enhancement may occur associated with CH17.

Geomagnetic activity is forecast to be mainly Quiet (Kp 0-2) with a chance of isolated Unsettled (Kp 3) intervals days 1 and 2 (21st and 22nd). Days 3 and 4 (23 and 24 Feb) activity may increase Unsettled to Active (Kp 3-4) at times, with a chance for an increase to G1/Minor Storm (Kp 5) levels on day 3 due to possible glancing CME's , and a slight chance on day 4 due to the possible arrival of a weak HSS.

Energetic Particles / Solar Radiation: High energy proton flux is expected to persist at background. High energy flux is expected to be mainly Moderate, with a slight chance of rising to High at first. Later in the period, if any slightly enhanced geomagnetic activity occurs, the high energy flux is likely to decrease to background to moderate levels. The associated 24 hour fluence is expected to remain below Active.

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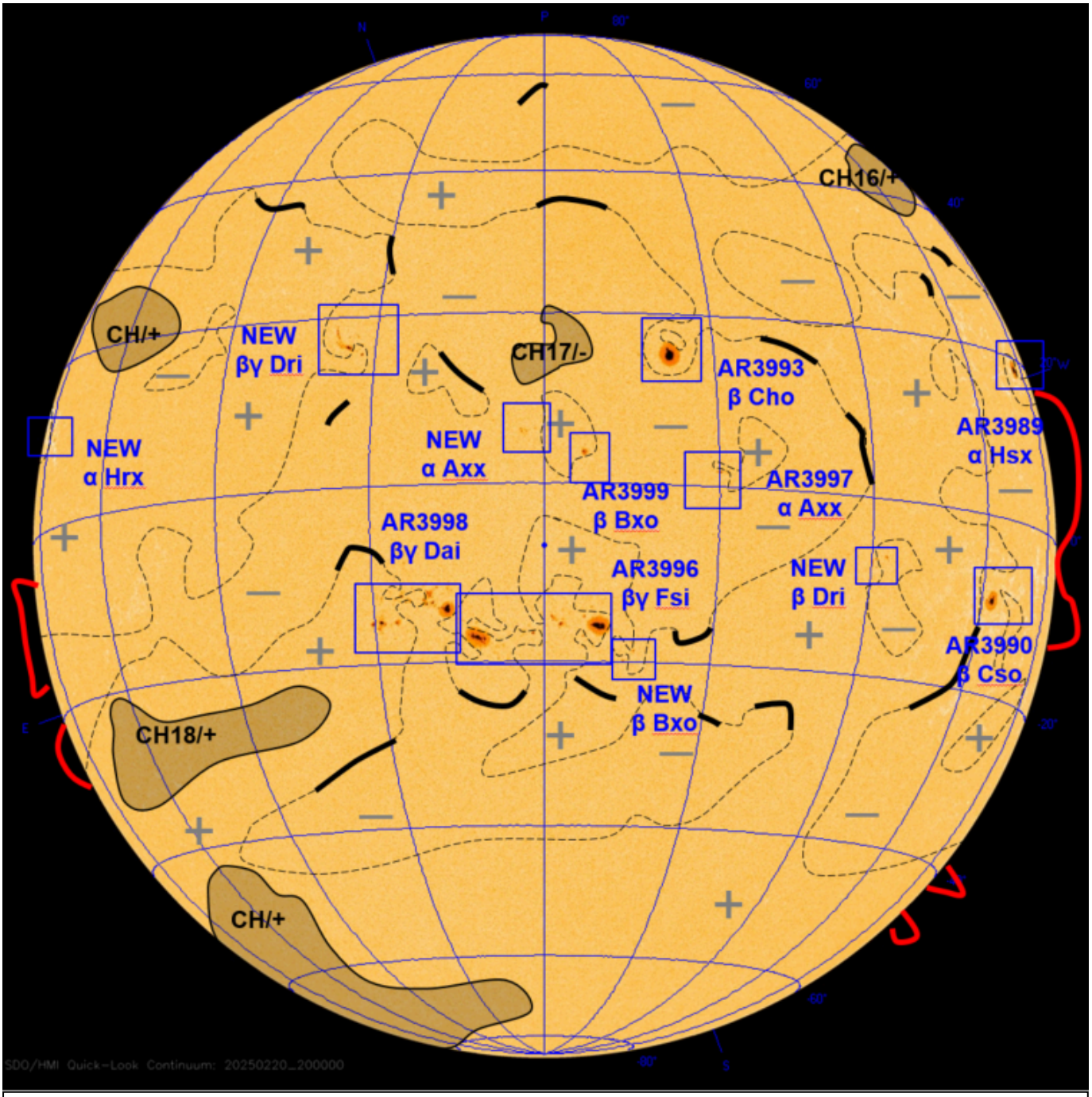
Figure 1: Synoptic Map valid 20/2000 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

A CME followed a C8 flare at 19/2345 UTC from a now decayed region in the southwest, with modelling results indicating a chance of a glancing blow around the middle of the day (UTC) on day 3 (23 Feb). There is a lower chance of a slightly faster CME brushing Earth early on day 3, from flaring that occurred in the vicinity of AR3996 on the 20th.

No significant solar wind enhancements are expected over the next few days, with a gradual easing trend within background levels expected from the residual influence of CH15. Late Day 4 (24th) a slight enhancement may occur associated with CH17/- , although this is low confidence due to the northward position of CH17 relative to Earth. This is a small, weak feature seen in imagery and so only slightly elevated winds of around 400-450 km/s are expected. However, as CH17 is negative and the spring equinox is approaching, if a connection occurs there may be a slightly greater geomagnetic response to a weak HSS than normally expected.

Geomagnetic activity is forecast to be mainly Quiet with a chance of isolated Unsettled intervals days 1 and 2 (21st and 22nd). Days 3 and 4 (23 and 24 Feb) activity is may increase Unsettled to Active (Kp 3-4) at times, with a chance for an increase to G1/Minor Storm (Kp 5) levels on day 3 and a slight chance on day 4.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	30	20
Strong	G3	No	1	1	5	5
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
20/0514	Partial	ex-AR3991	SW	438	23/1200UTC +/-6 hours	Chance of a glancing blow.
20/1409	Partial	Nr AR3996	SE	838	23/0300UTC +/- 6	Slight chance of a glancing blow.

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Figure 2: MOSWOC Enlil model.

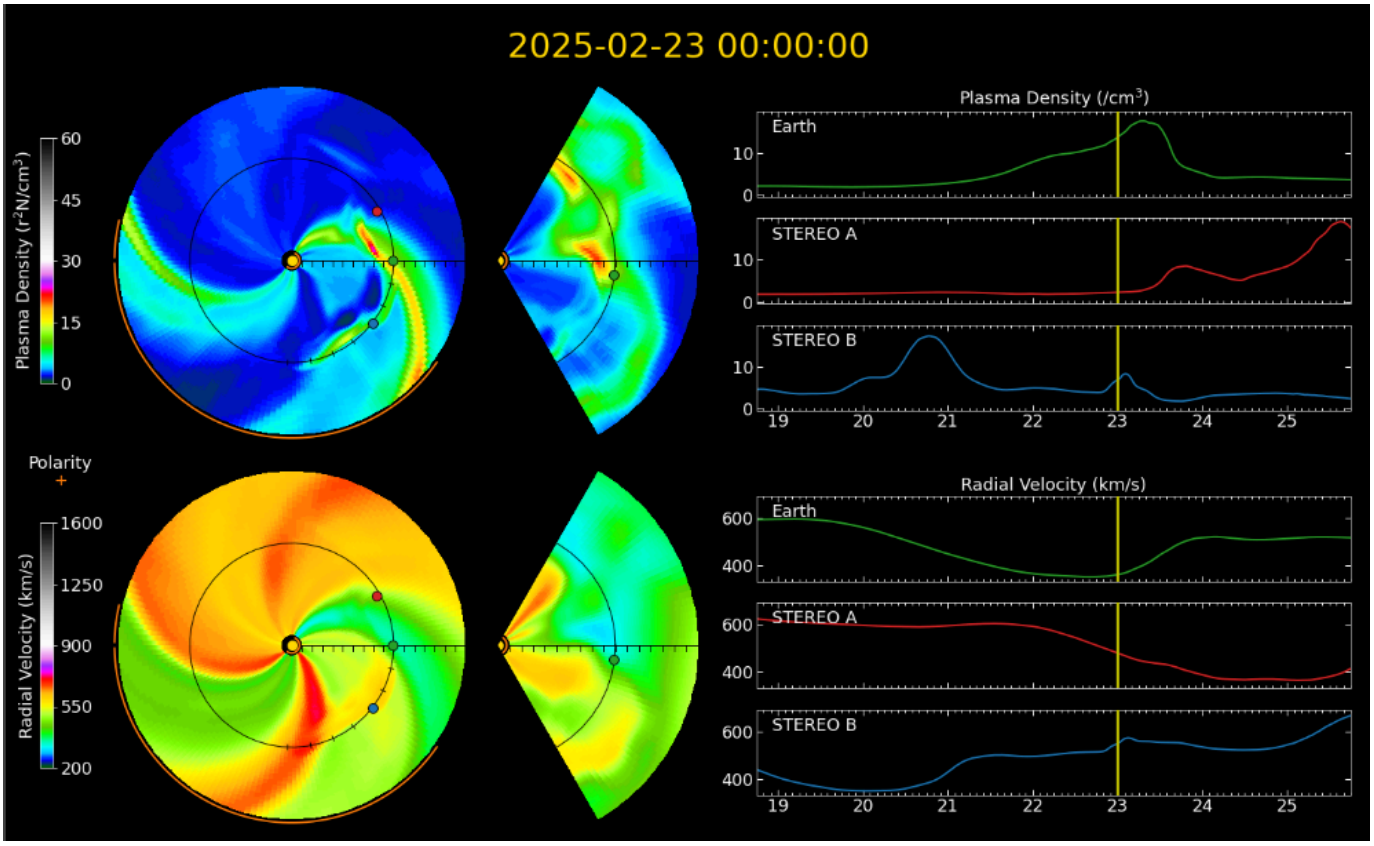

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Figure 3: MOSWOC Enlil ensemble showing some members indicating weak CME arrivals on the 23rd.

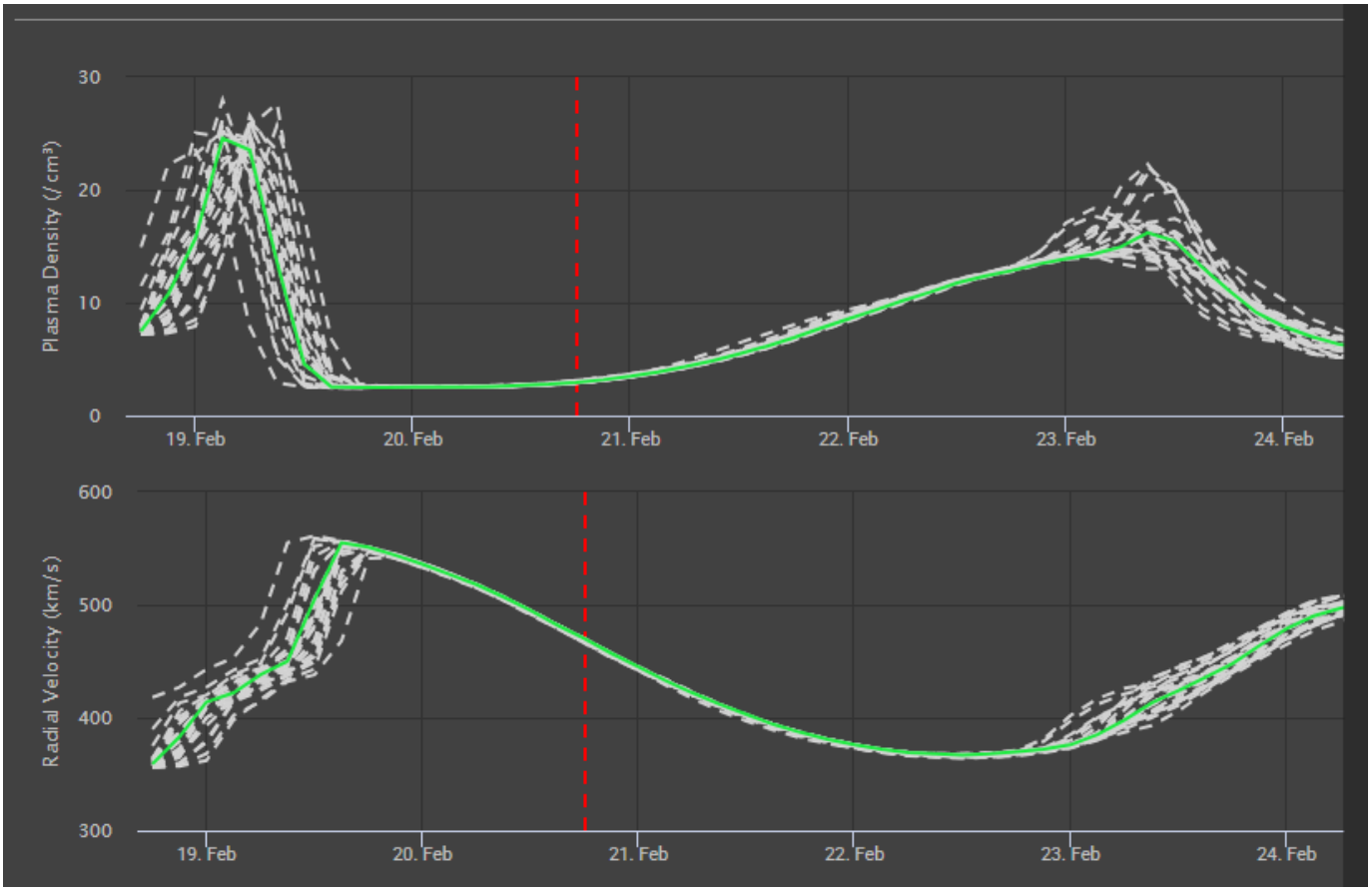
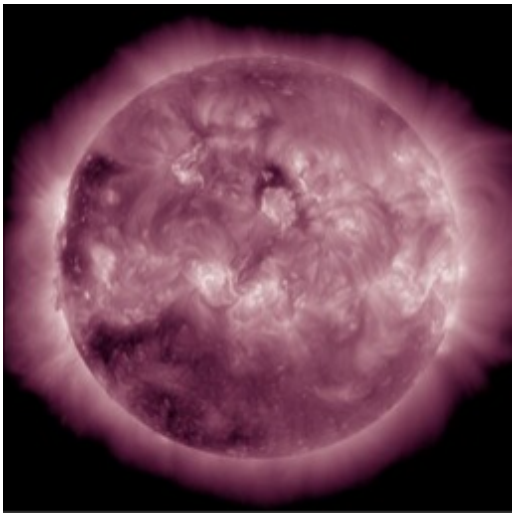


Figure 4: Latest SDO AIA 211 image showing CH17, a small feature in the northern hemisphere almost centre disc.



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Radio Blackouts - X-Ray Flares

There are seven numbered sunspot regions on the visible disc, however most of these are either relatively small and simple, or with little growth or development observed. The most notable regions remain the moderately large AR3998 and AR3996 in the southeast, both have exhibited a slight increase in spot number or area, with also an increase in flare activity at times on 20 Feb. If development continues within AR3998 then a weak delta spot could potentially develop within a small intermediate spot group. Some new minor spots have emerged in the southwest and northeast quadrants, with the region in the northeast developing some magnetic complexity within the growing spots and rudimentary penumbra and is now classified as a Dri/beta-gamma. Also, small returning region has recently rotated onto the northeast limb.

Solar activity has been Low with peak flare C4.9 at 20/1501 UTC from AR3996. Low activity is expected to continue with a chance of increasing to Moderate due to isolated M-class flares.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	40	40	50	50
Very Active	R3-R5 (X Class)	No	5	5	5	5

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Solar Radiation Storms (High Energy Protons)

GOES18 high energy proton flux is most likely to persist at background levels. Most sunspot regions currently in the western disc are unlikely to produce flares that would result in the release of Earth-directed high energy protons, however as AR3996 and AR3998 transit westward through the period this risk increases slightly.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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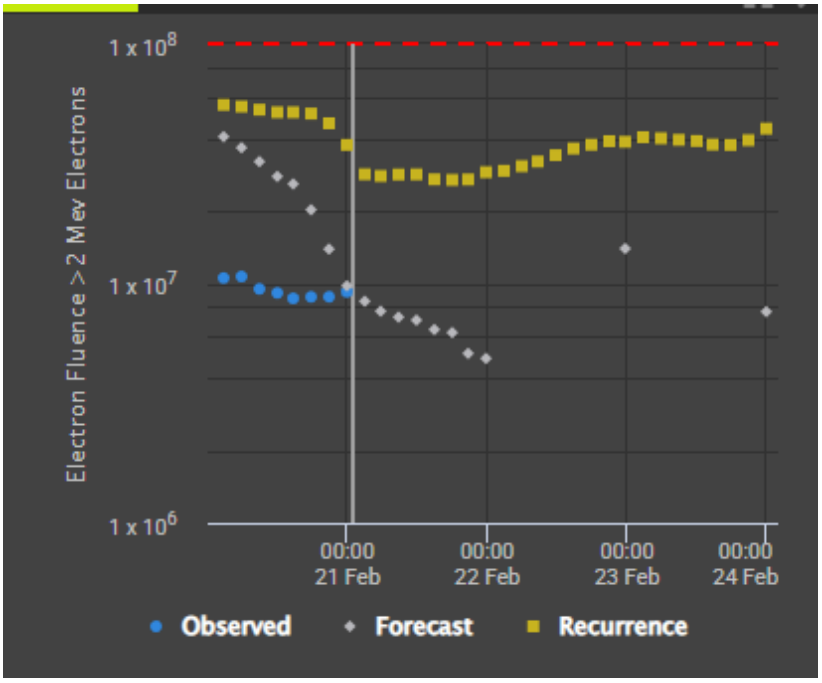
High Energy Electrons (≥ 2MeV)

High energy electron flux, as observed at GOES-16 is now at persistently Moderate. As solar winds ease, the observed flux at GEO may rise still rise a little, with a chance of reaching a diurnal high peaks until day 3 (23rd). Days 3 and 4 slightly increased geomagnetic activity is possible, with the high energy electron flux then declining to background to moderate levels.

The associated 24 hour fluence is currently below the Active level, and expected to persist below this level, as indicated by the MOSWOC REFM model. However, unlike the REFM model, a steady or slightly increasing trend is expected days 1 and 2 (21st and 22nd), with a likely declining trend thereafter.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	10	10	5	5
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 5: Latest MOSWOC REFM model.



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